Cognitive Evaluation of the Predictors of Use of Computerized Protocols by Clinicians

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ABSTRACT

We describe a cognitive approach to evaluating the factors that motivate clinicians to use computerized protocols. Using Value-Expectancy theories we developed an open-ended interview with providers experienced with using computerized protocols to assess clinicians' beliefs and experiences about the use of computerized protocols. Using a qualitative methodology, 3 reviewers independently identified key concepts raised by 13 interviewees. These concepts were aggregated and independently sorted into 39 categories. Then final categories were chosen by consensus. Analysis of the concepts showed consistency across clinician specialties of physicians, nurses and respiratory therapists. Inter-rater reliability calculated using Cohen's Kappa was 0.474. Identified constructs from Value-Expectancy and Intrinsic Motivation theories were: Work Importance, Perception of Situation, Role Relevance, Beliefs regarding Control, Beliefs regarding Normative Expectations, Beliefs regarding Self-Efficacy, Attitude, Habit, Environment and Behavioral Intention. This model will form the basis for an instrument to assess the beliefs and expectations of clinicians regarding use of computerized protocols.

INTRODUCTION

A major barrier to the implementation of evidence-based or consensus techniques of care, lies in the domain called the "behavioral bottleneck". Providers fail to adopt and implement valid evidence-based interventions for a variety of reasons.[1] With the increasingly widespread use of computerized protocols as decision support tools in medicine, an understanding of the factors that influence clinicians' to use such protocols will be helpful.

We focus on development of a model identifying the predictors of clinicians' use of computerized protocols, drawing from cognitive science and socio-behavioral theories.

We developed a model utilizing the constructs of Value Expectancy Theories as well as Intrinsic Motivation Theory.[2] The constructs underlined in the proposed model highlight the factors that motivate clinicians to use computerized protocols. Beliefs and expectations regarding outcomes and the value individuals put on those outcomes are key predictors of human behavior.[3, 4,5]

A determination of the specific expectancies and beliefs is an essential first step in the development of an instrument that can be used to quantify overall attitudes. Such an analysis would help in successful implementation of computerized protocols, by allowing administrators to comprehend, the needs of the end-users.

BACKGROUND

Value-Expectancy theories, such as The Theory of Planned Behavior[6] have been used in a variety of domains to predict behavior. Previous studies have shown that motivation variables such as interest, values and affect were better at predicting behavioral adoption of computer systems than user satisfaction.[7]

Most[8] but not all[9] researchers agree that one's motivation is greatest for those activities that are consistent with the values that one holds. Motivation to engage in a behavior that is not externally forced is called "intrinsic motivation." Intrinsically motivated individuals appear highly involved,[10] hold beliefs congruent with their commitment,[11] approach and explore,[12] experience intense interest, [13] and positive affect.[13]

Cognitive Science has been applied in medical informatics to gain understanding of problems that lie beyond the issues of developing technology and border on the issues of the interaction of human

Statements	Clinicians
simple protocols are better on paper	MD 1, MD 6
makes the job easier for the nurse and saves her time	MD 1, MD 2, MD 3, MD 4
help decrease co-ordinator's work	MD 1, MD 2, MD 5, RN 1
comp.protocols are difficult to maintain and modify	MD 1, MD 5, RN 1
should be at the bedside for convenience	MD 1
standardization of care and more consistent decisions	MD 1, MD 2, MD 5, MD 6, RN1
ability to do data transfer, data analysis	MD 1, MD 2, MD 5, MD 6
for proper exportation we need to export the culture as well	MD 1, MD6
use of computerized protocols cant be made compulsary	MD 1
blindly following instructions given by the computer is a problem	MD 1, RN 3
improve outcomes	MD 1, MD 2, RN 3
reduce costs	MD 1
I don't have a fear for computers	MD 1, RN 1
you need the proper infrastructure in terms of men and machines to implement them	MD 1, MD 2, MD 3, MD 4
confidence depends upon familiarity and experience with the protocol	MD 2, MD3, MD 6, RN 2
comp. Protocols require less interpretation	MD 2, MD 6, RN 1
inconvenient to the nurse because of double charting	MD 2, MD3, RN 1, RN 2
fewer mistakes and deviance from the standardized therapy	MD 2, MD 3, MD4, MD 5, MD 6, RN 2
over time the computer will save resources	MD 2, MD 6, RN 1, RN 3
can collect large amounts of information about patients and hence more accurate	MD 2

Table 1- Examples of extracted statements from clinicians' interviews

beings with technology.[14,15,16,17] Research conducted in informatics to identify the predictors of motivation, has mainly focused on one variable, i.e. attitude[14] and failed to capture the other predictors of motivation.

The goal of this study is to identify the potential predictors of clinicians' use of computerized protocols by applying the constructs of Value-Expectancy Theories and the Intrinsic Motivation Theory.[2]

METHODS

Development of the open-ended interview: The constructs of the Theory of Reasoned Action were used for the development of the open-ended interview, which consisted of asking clinicians' about their use of computerized protocols. Twenty-one open-ended, interrogatory statements regarding clinicians' experiences were created.

Sample: We used a convenience sample of Physicians (MD), Registered Nurses (RN) and Respiratory Therapists (RT) from LDS and Cottonwood Hospital in Salt Lake City, Utah and McKay-Dee Hospital, Ogden, Utah. Six Respiratory Therapists, 5 Physicians and 3 Registered Nurses, with previous experience in the use of computerized

protocols were interviewed. Most of them had been associated with the development of computerized protocols at the LDS Hospital. We regarded previous experience to be essential in determining the underlying beliefs and expectations that might prove to be useful during the development of the final questionnaire.

The choice of the sample might have given rise to two known biases. Firstly, because the interviewer was carrying out face-to-face interviews and the interviews were being recorded the respondents might have felt pressurized to respond positively about their views regarding computerized protocols. However, over the course of the interviews it was evident that the clinicians who were chosen had strong opinions regarding both the advantages as well as the disadvantages of implementing computerized protocols. Secondly, some of the clinicians' chosen for the interview, had been closely associated in the developmental process of computerized protocols, at LDS Hospital. This might have biased their opinions positively regarding use of computerized protocols. We considered the bias a positive influence, since previous experience with use of computerized protocols could uncover aspects of use that might have been omitted, during the design of the open-ended interview.

The Interview Process: Face-to-face interviews were carried out (except for one clinician who chose to be interviewed over the telephone), during work hours. All interviews were recorded with prior permission of the interviewee.

Concept Development: The interviews were transcribed word for word; the answers were neither shortened nor altered in any form to avoid researcher bias.

Clinicians' comments were extracted from the transcribed interviews. The comments were listed (Examples in Table 1) and ultimately aggregated into conceptual categories. A flow diagram representing the steps, in the process of model development, has been shown in Figure 2.

Three independent reviewers, with a background in social science, extracted statements that referred to relevant concepts associated with clinicians' use of computerized protocols. These statements or segments of statements were the basic units of analysis for the identification of concepts. The reviewers generated three independent sets of concepts.

Category Development: Categorization of all three concept sets was first done independently by each of the three reviewers. . Each reviewer received 3 sets of cards, one of their own and two of the other reviewers. Each reviewer was asked to put all of the items into their own categorization scheme. No limits were put on the number or type of categories. The results were then compared, discussed and a consensus developed by an iterative process. The result was a set of 39 categories, one example of which is listed in Figure 3.

Determination of Model Constructs (Figure 4): Model constructs were derived from a combination of three theories, specifically the Theory of Reasoned Action, the Theory of Planned Behavior and the Self-Determination Theory (an Intrinsic Motivation theory).

The effectiveness of the model was tested by having two independent reviewers assign the 39 categories to one of the 10 model constructs. All of the 39 categories could be placed into the 10 model constructs.

The definitions of the model constructs are:

Work Importance: An individual's tendency or orientations to value work in general.

Perception of Situation: The way that a situation is categorized or defined by the person. Chronic roles, well-learned habits and over-arching goals will impact how the situation is perceived.
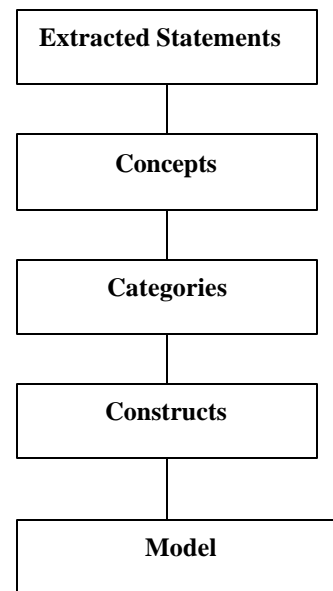

Figure 2- Flow diagram highlighting the steps in the development of the model

Figure 3- One example of a category with the underlying concepts

Role Relevance: The belief that the situation or action is relevant to the individual's role. For example, a person's belief about being clinically responsible is a significant contribution to how the individual carryies out the relevant behavior.

Beliefs regarding Control: The belief that the behavior elicited is freely determined.

Beliefs regarding Self-Efficacy: The degree to which one believes that one has the skill to effectively engage in the behavior.

Attitude: A general positive or negative judgment regarding the behavior or the intervention.

A. Outcomes

The list of positive and negative outcomes and consequences that a person believes would occur when the behavior is engaged in. These

include benefits, costs, and affective consequences (enjoyment, interest).

B. Expectancies

The degree to which an individual judges that a particular outcome is likely to occur if the behavior is executed.

C. Value

The value or importance that an individual holds for a specified outcome.

Habit: Behavior that is well learned, frequently executed occurs easily and with little stimulation – almost automatically.

Environment: The degree to which the environment is perceived as supportive, including organizational leaders, the physical structure and even "help".

Behavioral Intention: Intentions and expressed commitment is known to be a good predictor of behavior.

Behavior: Behavior would be measured by compliance, user satisfaction and the degree to which clinicians' explore computerized protocols.

RESULTS

We were able to adequately categorize the 39 empirical constructs into the theoretical model with an inter-rater reliability (calculated using Cohen's Kappa) of = 0.474. Disagreement among reviewers stemmed from 3 constructs: Work Importance, Attitude, and Beliefs regarding Self-Efficacy. We changed the model to accommodate this disagreement (Figure 4). Identified model constructs were: Work Importance, Perception of Situation, Role Relevance, Beliefs regarding Control, Beliefs regarding Normative Expectations, Beliefs regarding Self-Efficacy, Attitude, Habit, Environment and Behavioral Intention.

DISCUSSION

Computerized protocols require appropriate knowledge representation of the complex medical domain. Despite the considerable amount of effort and research that has gone into the development of these protocols, few institutions have been able to implement them with much success. The focus thus far, in the development of these protocols, just like other decision support systems, has been on incorporating the latest technology without paying much attention to whether these protocols can be incorporated seamlessly into the workflow of the clinicians and meet their needs. [17,18]

In this paper, we have used well-established theories from cognitive and social science and applied them to a problem in medical informatics. The methodology led to the development of concepts, categories, constructs and eventually the model that are oriented towards understanding the problem of what predicts use of computerized protocols among clinicians. Our model identifies constructs that will enhance our understanding of the factors that enhance or impede clinicians' use of computerized protocols. Our results have led to the development of a questionnaire, currently under evaluation.
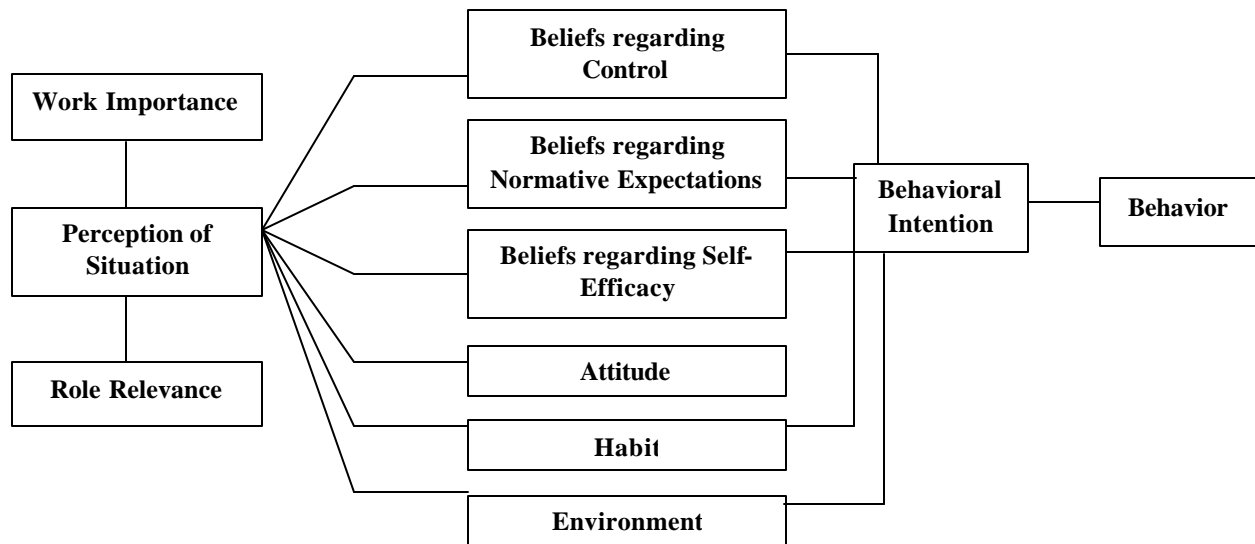

Figure 4 - Model predicting use of computerized protocols among clinicians

We argue that an understanding of the attributes that determine acceptance of computerized protocols by clinicians will be critical to implementing them successfully. Clinicians who seek expert systems for clinical decision-making will perceive these protocols as useful if they improve practice rather than merely automate the existence of paper-based protocols.

CONCLUSIONS

In conclusion, applying cognitive approaches may provide a sound basis for widening the "behavioral bottleneck" in the implementation of computerized protocols. Results from this study can improve our understanding of the strategies and problems encountered by administrative heads at institutions trying to incorporate these protocols into practice. We are continuing analyses of clinicians as they interact with computerized protocols and this information can serve as valuable feedback for designing protocols that meet their needs.

Acknowledgements

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